CONTRACT No. N00014-94-C-0210 BETWEEN
the OFFICE OF NAVAL RESEARCH and NEOCERA, INC.

THIRD MONTHLY PROGRESS REPORT
dated December 21, 1994

1. Introduction

The goal of this SBIR Phase I project is to establish the feasibility of designing a High Temperature Superconductor (HTS) Superconducting QUantum Interference Device (SQUID) microscope in order to detect defects, and verify customizations and repairs in MCM substrates. The overall goal of this SBIR program is to market an HTS SQUID microscope dedicated to the inspection of MCM substrates in a manufacturing environment. Neocera and its subcontractor, the Center for Superconductivity Research at the University of Maryland, are working collaboratively in this effort.

Initial efforts have focused on: demonstrating that a room temperature object can be brought sufficiently close to a cryogenically-cooled SQUID sensor to image electrical defects (shorts, opens, voids, particulate contamination, etc.); constructing a room temperature sample stage; and assembling the sensor control and readout electronics.

2. Sensor development

As reported during the previous period, a technique was developed by which a small high-T_c SQUID sensor could be attached to an electrically insulating tip. During this period, an improved prototype was fabricated from a ground sapphire rod instead of a glass rod. In this fashion, the sensor can be electrically isolated but thermally connected to the dewar and cryogen. A major obstacle was overcome when low resistance (~0.5Ω) contacts were successfully made to the sensor chip. Connecting leads was difficult due to the small size of the point and the small area of the contacts.

In addition to the sensor tip itself, all ancillary wiring to connect the sensor and coils to the room temperature feedback electronics were installed. The SQUID readout electronics was also completed and installed in the dewar support stand.

3. Sensor window

One of the primary components needed to separate the cold sensor from the warm sample was assembled and successfully bench tested: the sensor window. Since the sensor needs to be cooled

to near liquid nitrogen temperature in order to operate, the window must act to separate vacuum from atmosphere in order to obtain thermal isolation. However, the sensor must be brought as close as possible to the sample under test at room temperature, implying a thin window. The solution was a very thin (~25μm) sapphire plate. A prototype sapphire window has been constructed, and performs adequately for the task.

4. Dewar assembly

The dewar, dewar support stand, and internal fixturing for the window and sensor support were all completed. In particular, the support stand was stiffened, the vacuum can to separate the sensor from atmosphere, and the sensor positioning mechanism were completed and tested.

A preliminary round of testing of the dewar, window, and positioning mechanism was successfully completed. For the tests, a small brass point was attached to the end of a cold copper rod, the sensor can was evacuated, the sapphire window was moved into place, and liquid nitrogen was added to the dewar. With the system cold, the relative position of point and window was readily controlled. Also, leak testing did not reveal any leaks, either through the window or the dewar. Finally, the concern that the window might frost up when the cold point was brought close was proven to be unfounded. No icing or condensation was seen on the window.

5. Plans for the Next Period

- Install the SQUID sensor assembly into the support fixture, cool down and test electronics.
- Receive and install magnetic shielding
- Begin full testing of the prototype HTS SQUID microscope.

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